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AUTHOR Sparling, Joseph J.; And Others
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ABSTRACT

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# Conjoint Scaling as a Decision Aide in Curriculum Development[1]

Joseph J. Sparling, University of North Carolina at Chapel Hill[2]
Frances A. Campbell, University of North Carolina at Chapel Hill
Grace W. Templeton, Charlotte-Mecklenburg (N.C.) Schools
E. Janice Wheelon, University of North Carolina at Chapel Hill

*ABSTRACT*

In a series of three independent studies (focusing respectively on the classic sources of curriculum: the learner, society and subject matter) data were gathered that might bear on the choices facing the curriculum developer. Data from the learner tentatively revealed what characteristics of pictures affected the deployment of third grade children's visual attention. Data from the society provided increased awareness of the structure and direction of a group of mothers' goals for their infants. Subject matter data from an expert judge provided useful suggestions for the organization of content for a preschool motor curriculum. In each of these studies, polynomial conjoint scaling, a form of multi-dimensional scaling, reduced a complex matrix of data to a simple visual display which was useful to the curriculum developer in his decision making process.

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[1]Paper presented at the 1977 Annual Meeting of AERA

[2]Inquiries regarding this paper should be addressed to:
Joseph J. Sparling, FPG Child Development Center, Highway 54 Bypass West, Chapel Hill, North Carolina 27514



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# Conjoint Scaling as a Decision Aid in Curriculum Development

Joseph J. Sparling, Frances A. Campbell,
Grace W. Templeton and E. Janice Wheelon

Objectives. Frequently the sources from which curricula flow (the value judgements, the assumptions, etc.) remain hazy and inaccessible to both the curriculum developer and the curriculum user. There are perhaps many reasons why we, as curriculum developers, typically have not documented the sources or forces which affect our decision making. Chief among these may be that curriculum users have not demanded this information. But consumerism is an idea whose time has come for curricula as well as for foods and automobiles. Today it is appropriate to supply the curriculum user with not only test results on the effects of the curriculum but also to supply information on the curriculum sources. This additional information may be analogous to supplying on the label on a food package not only the fact that it contains X grams of protein but that its source is vegetable protein rather than animal.

The purpose of this paper is to illustrate one procedure for clarifying and extracting useful information from curriculum origins or sources. Such procedures can help the curriculum developer to do his or her work at a higher level of awareness and when the product is ready for dissemination to describe it (provide the fine print on the label) more adequately.

Theoretical framework. The theoretical position of Ralph Tyler (1950) identified the classic sources of curriculum as 1) the learner, 2) the society, and 3) the subject matter. This research took each of these sources in turn and through a single methodology explored the problem of analyzing information so that it could inform the decisions of the curriculum developer.

Data sources. Data were gathered from three independent sources representing respectively the learner, the society and the subject matter.[1] The population representing the learner were 15 public school third grade males in Chapel Hill, N.C. The population representing opinions of one particular strata of the society was made up of the mothers (27 total) of two cohorts of high risk infants enrolled in an early intervention program of the Frank Porter Graham Child Development Center. Subject matter was represented by a kindergarten teacher from the Frank Porter Graham Center acting as an expert judge. In each case, the data represent an interim report. Additional data are being gathered as a continuing refinement of input in the on-going curriculum development decisions.

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[1]It would have been informative to have collected data from the three sources within a single curriculum project. However, since this was not possible within the on-going projects of the authors, we choose to illustrate the three curriculum sources from three separate studies.

Methods. In each of the three areas of this study, data were gathered that might bear on the choices facing the curriculum developer. The data were analyzed in each case using polynomial conjoint scaling (Young, 1973), a form of multidimensional scaling. The following sections describe in turn the application to each area. It is not the purpose of this paper to fully describe each as a complete study with detail adequate for replication. [Templeton (1975) supplies this amount of detail on the methodology of the first study.] Rather than dealing with the methodology per se, the following sections will give attention to the usefulness of the methods as an aid in the decisions of the curriculum developer.

What properties of information can cloud the decision making of the curriculum developer? First there is information which contains imbedded hypotheses. This may be especially true for information regarding the learner. The curriculum developer may find that most or all the available research findings bearing on a decision he or she faces is unduely limited by the hypotheses of the original investigators. This was the case in the investigation which follows under the heading *the learner*. Conjoint scaling was of aid in this instance by providing a methodology for generating rather than confirming hypotheses.

A second quality of information which may concern the curriculum developer is complexity. For example, value judgements or perceptions may exist in such large numbers that they are difficult if not impossible to deal with directly. And since individuals make their value judgements simultaneously on several bases, a simple one-dimensional scaling of the judgements is often inadequate. The second and third investigations which follow under the respective headings of *the society* and *the subject matter* illustrate the usefulness of conjoint scaling as a method of reducing a complex matrix of relative judgements of curriculum goals to a simple physical picture which interrelates the goals as points in an n-dimensional space.

*The learner*. In designing pictorial material for children the curriculum developer naturally turns to the substantial research literature on children's visual attention and picture preference. A brief review of one of the best of these studies illustrates the problem facing the curriculum developer. Stewig (1974) asked 1,078 elementary school children to indicate their preference in pairs of pictures (slides). The pictures were varied on five visual components with only one variable manipulated at a time. The following combinations were used: (1) color very realistic versus color highly unrealistic; (2) shape defined as very flat objects versus modeled shapes presented in three-dimensional quality; (3) very realistically proportioned objects versus objects having very exaggerated proportions; (4) many details versus few details; and (5) very flat picture plane (space) versus very deep space. The results are very significant to the curriculum developer who agrees that the five visual components are, in fact, the salient ones. For the curriculum developer who disagrees or who suspects a complex interation of visual components, this and most other studies provide little help.

To avoid the problem of inadequate hypotheses, the present study displayed all possible pairs (190) of twenty pictures *randomly* selected from children's literature and recorded how the subject divided his time for each pair. The data, a dissimilarity score for each pair of pictures, were analyzed through conjoint scaling which generated in an n-dimensional space an array of 20 points representing the 20 pictures. Cliff and Young (1968, p. 270) in describing the benefits of this general method of analysis state that "...methods for multi-dimensional scaling provide much more useful ways of determining the subjective organization underlying the individuals reactions [to a set of stimuli] than was possible in the past.... The individual has, so to speak, a psychological map of the stimuli, and he uses it in various ways."

The points and the space generated through conjoint scaling of the responses of children to the pairs of pictures in this study may be thought of as analogous in some sense to the average psychological map those children use as a reference whenever they have to deal with the pictures. Dimensions or vectors within the space may be assumed to be analogous to broad characteristics (such as color, complexity or subject matter) which may have affected the children's visual attention. Thus clustered pictures have similar attractiveness and *perhaps* similar characteristics while pictures widely spaced have differential attraction and characteristics. By examining and interpreting the physical array the curriculum developer takes the initial steps in sorting out the elements he will attend to in designing pictorial material for children. The following paragraphs illustrate the interpretations.

One of the many arrays produced in this study is shown in Figure 1. Each block in the three-dimensional space represents a particular picture as perceived by a sample of 15 eight-year-old white males. The fact that the pictures with feminine content fell mainly on one side of the space while masculine content pictures fell on the other strongly suggests that this masculine-feminine attribute[1] was one of the bases on which the males divided their attention. The importance of this interpretation is underlined by the fact that masculinity/feminity of content has hardly been mentioned let alone studied in the vast majority of picture preference studies.

Other smaller clusters in the three-dimensional array have narrower interpretations. Figure 2 shows the proximity of three pictures each of which had red, white and blue as dominant colors. Figure 3 demonstrates the relationship of the only two pictures of the 20 which were rendered totally in black and white. Figure 4 might be labeled the cartoon style cluster. However, these three pictures demonstrate how several features may tend to appear in tandem in the real world of children's materials. Traits shared by these pictures were: (1) each had a cartoon-style appearance, (2) each picture contained one animal, and (3) each was rendered in one subdued color combined with black, white and gray. The pictures in a final cluster, Figure 5, seemed each to have a predominantly blue color and the content of each could be interpreted to have a threatening aspect.

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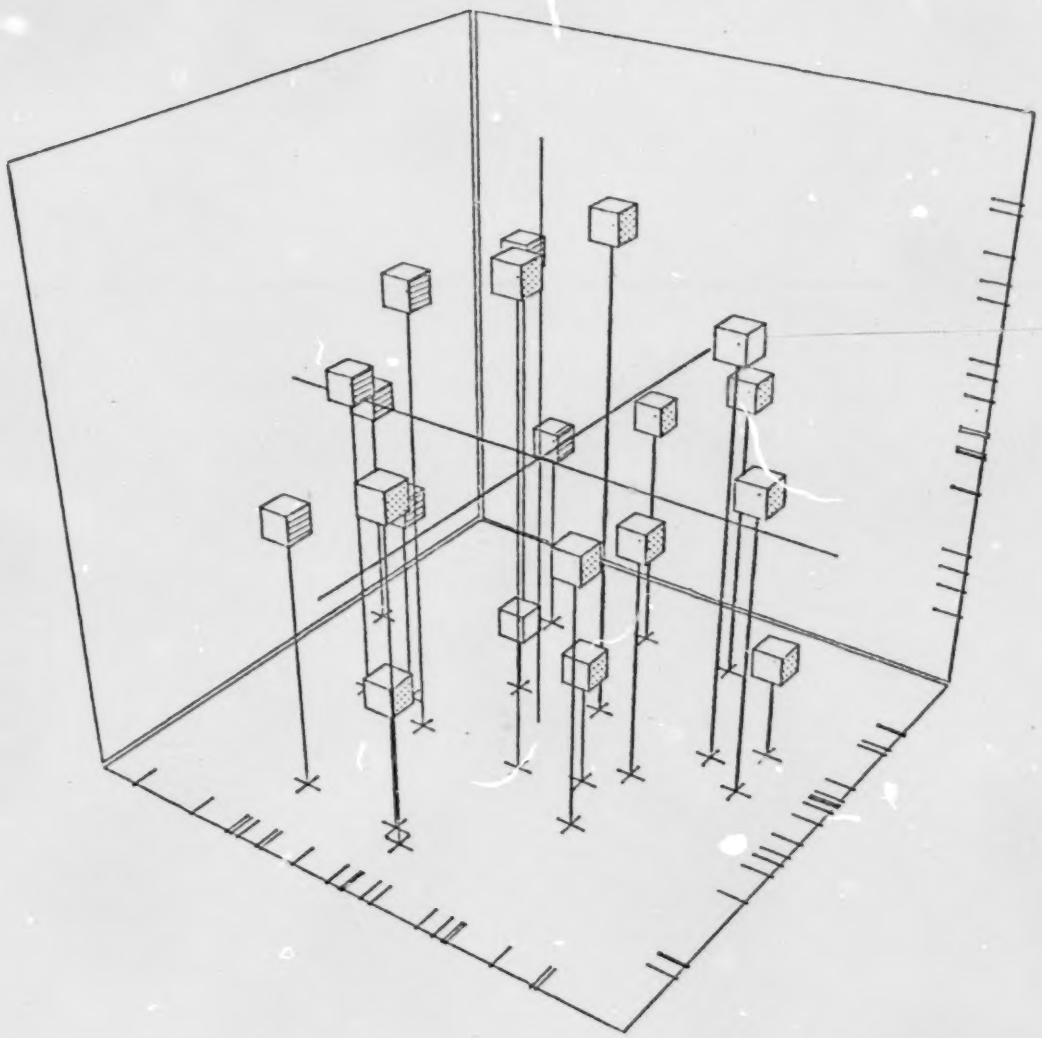
[1]The masculine/feminine interpretation was originally the researcher's but was later confirmed by ratings of seven expert judges.

Figure 1

Feminine-Masculine Separation of 20 Pictures



Legend

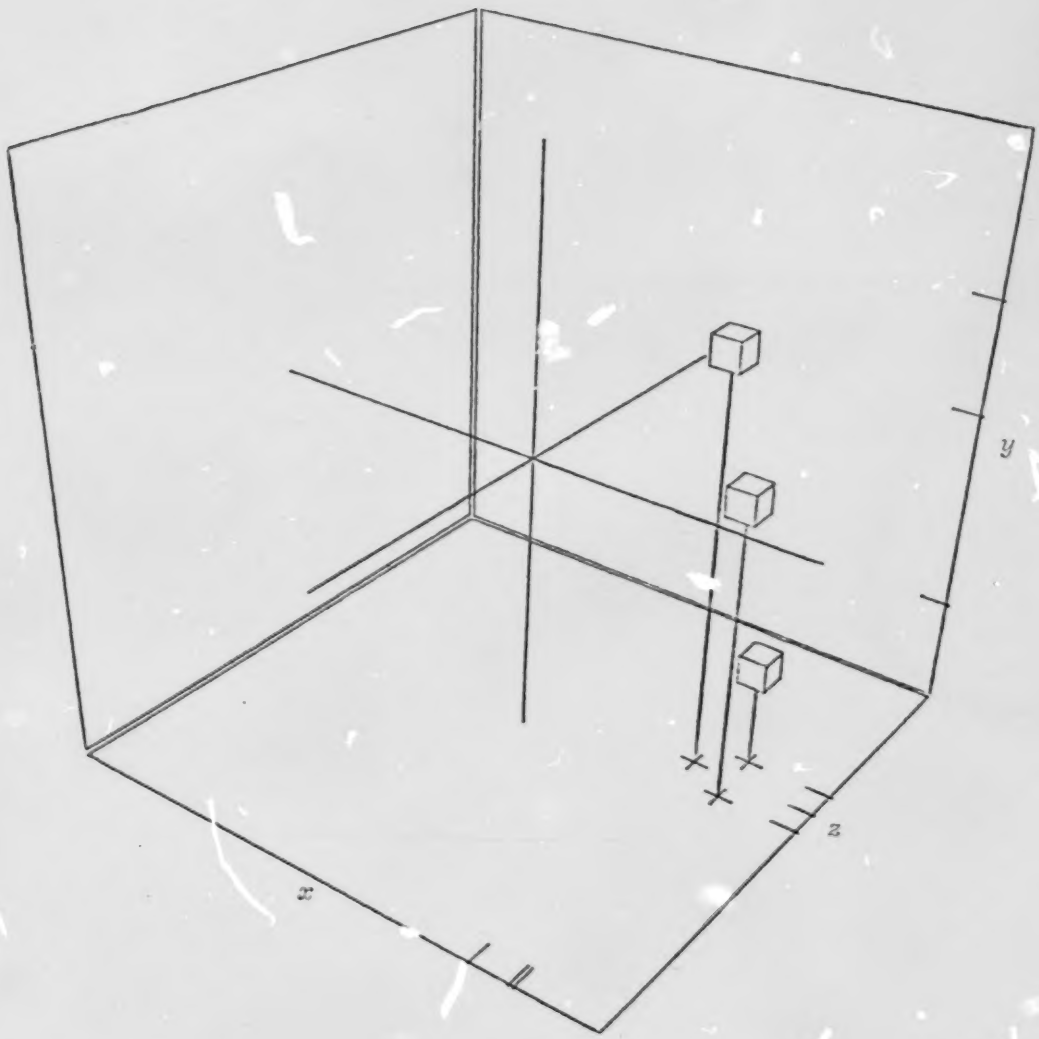
- Masculine Content

- Feminine Content

n = 15 eight-year-old males

Figure 2

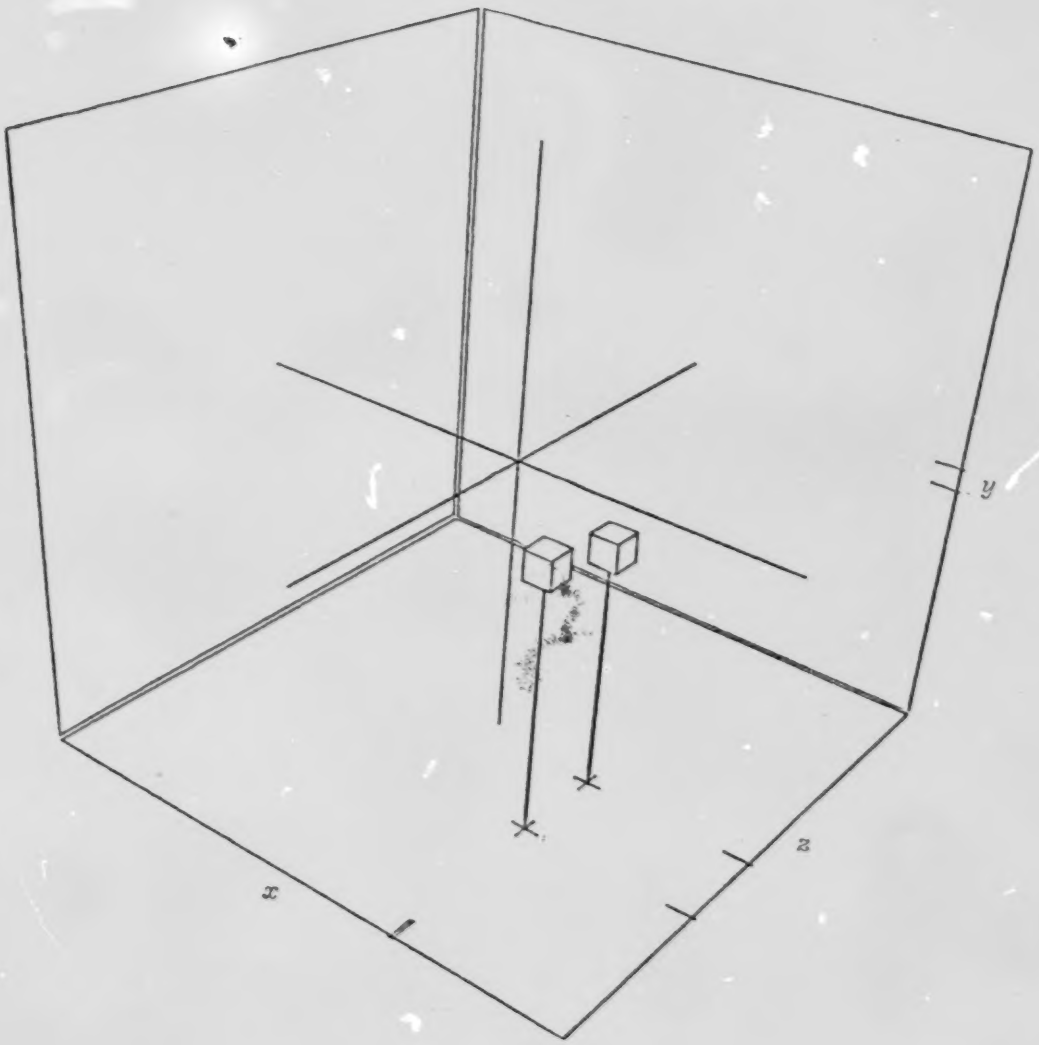
Red, White and Blue Cluster




n = 15 eight-year-old
males

Figure 3

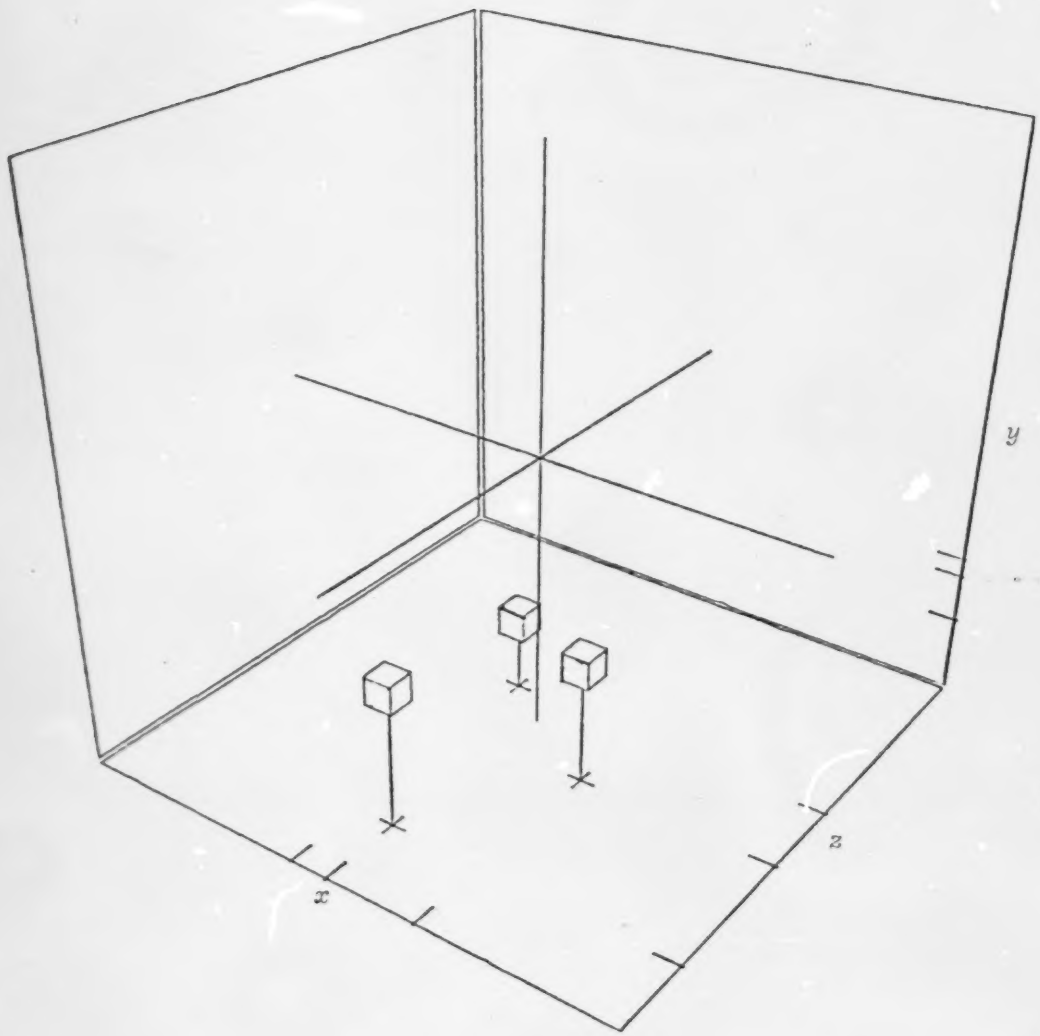
Black and White Cluster




n = 15 eight-year-old males

Figure 4

Cartoon Style Cluster

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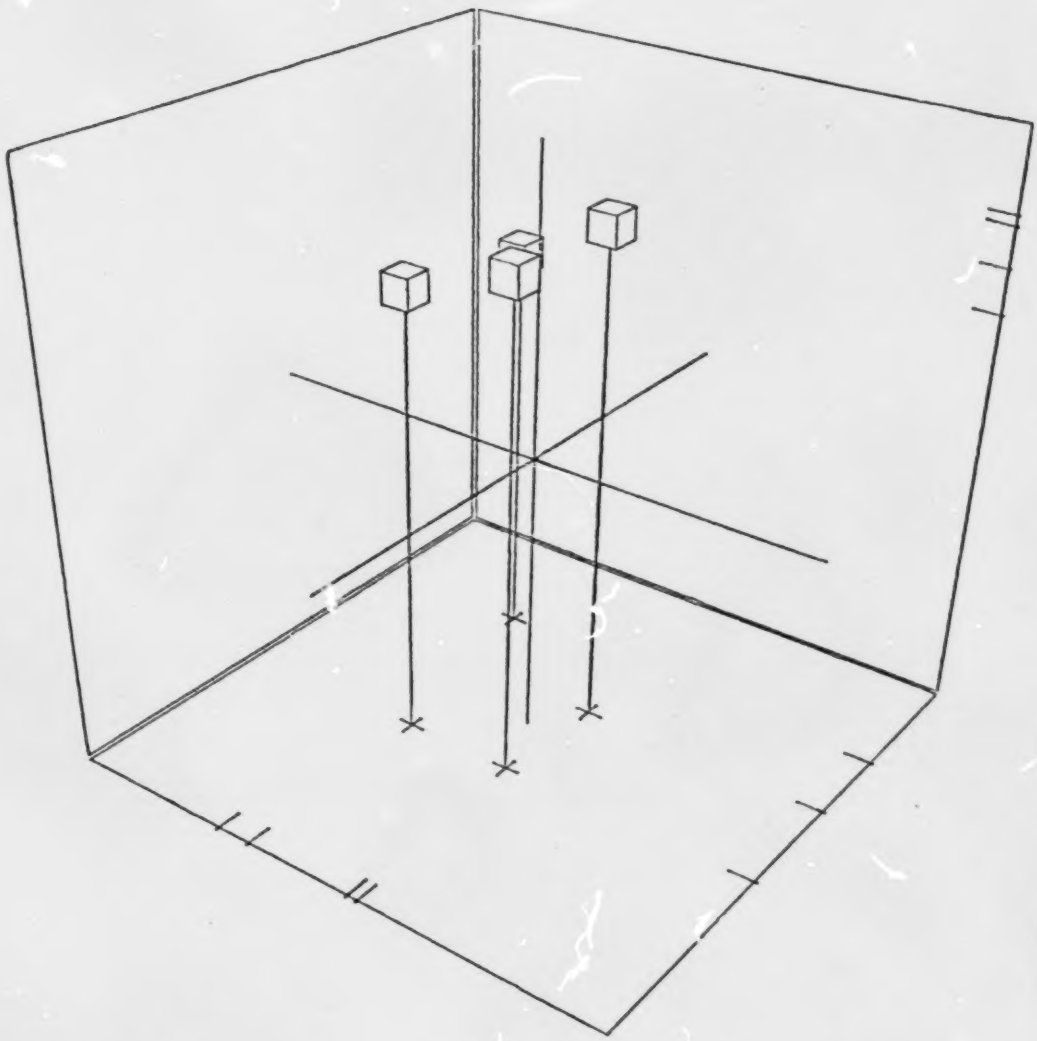
n = 15 eight-year-old
males

Figure 5

Threatening-Blueness Cluster



n = 15 eight-year-old males

The physical proximity on the plot of the members of each of these clusters suggests that the points are close to each other in the average child's psychological map of the pictures. In theory, the nearer two points are on a psychological map, the more nearly they are perceived to be alike in their attractiveness and/or their attributes. Therefore, it may be assumed that any choice (such as choosing what to look at) between points that are in close proximity would represent a more subtle decision than a choice between distant points.

This study represents an on-going initial planning phase for the development of pictorial curriculum materials. Sex and age of subjects will be varied in the next phases. Conjoint scaling is aiding the curriculum developer in freeing his decision making from the constraints of earlier studies. This creates the necessity for doing a substantial amount of basic ground work, but that seems a better use of time than concerning oneself with, for example, pictorial depth of field when pictorial content may be the variable of overriding importance.

*The society*. It is presumptious if not arrogant to design "intervention" programs for young children without learning about the aspirations and goals the parents hold for their children. However, the task of clearly stating one's goals may be difficult for anyone and doubly difficult for parents with modest verbal facility. To help parents formulate and communicate their goals in a longitudinal program for high risk infants, several sets of picture cards were devised. One set of cards illustrated 12 varied developmental tasks which most children achieve at 24 months of age; a second set illustrated 12 tasks typically achieved at 36 months of age. The tasks were selected to cover the widest possible range of social, motor, cognitive and language behaviors.[1] In addition to a photograph, each card had a verbal description of the task. For example, the words "Uses cup and spoon neatly" and an appropriate picture appeared on one of the 24 month cards.

When a child in the program reached 12 months of age, the parent was asked to think ahead to the time when the child would be 24 months of age. The mother was then given the set of cards for 24 months and asked to rank order them in terms of which tasks were the most important goals for her child. Likewise, a year before her child reached 36 months of age, the mother was asked to show through ranking the relative importance she placed on the various 36 month tasks or goals. These rankings, analyzed through conjoint scaling, provided and continue to provide an important parent input to the curriculum devleopment team of the intervention project.

A two-dimensional array of the 24 month developmental goals (Figure 6) showed the curriculum developers that the parents valued certain motor goals (F "Balance on one foot", S "Crawl backward downstairs", C "Scribble with a crayon") to a similar degree.

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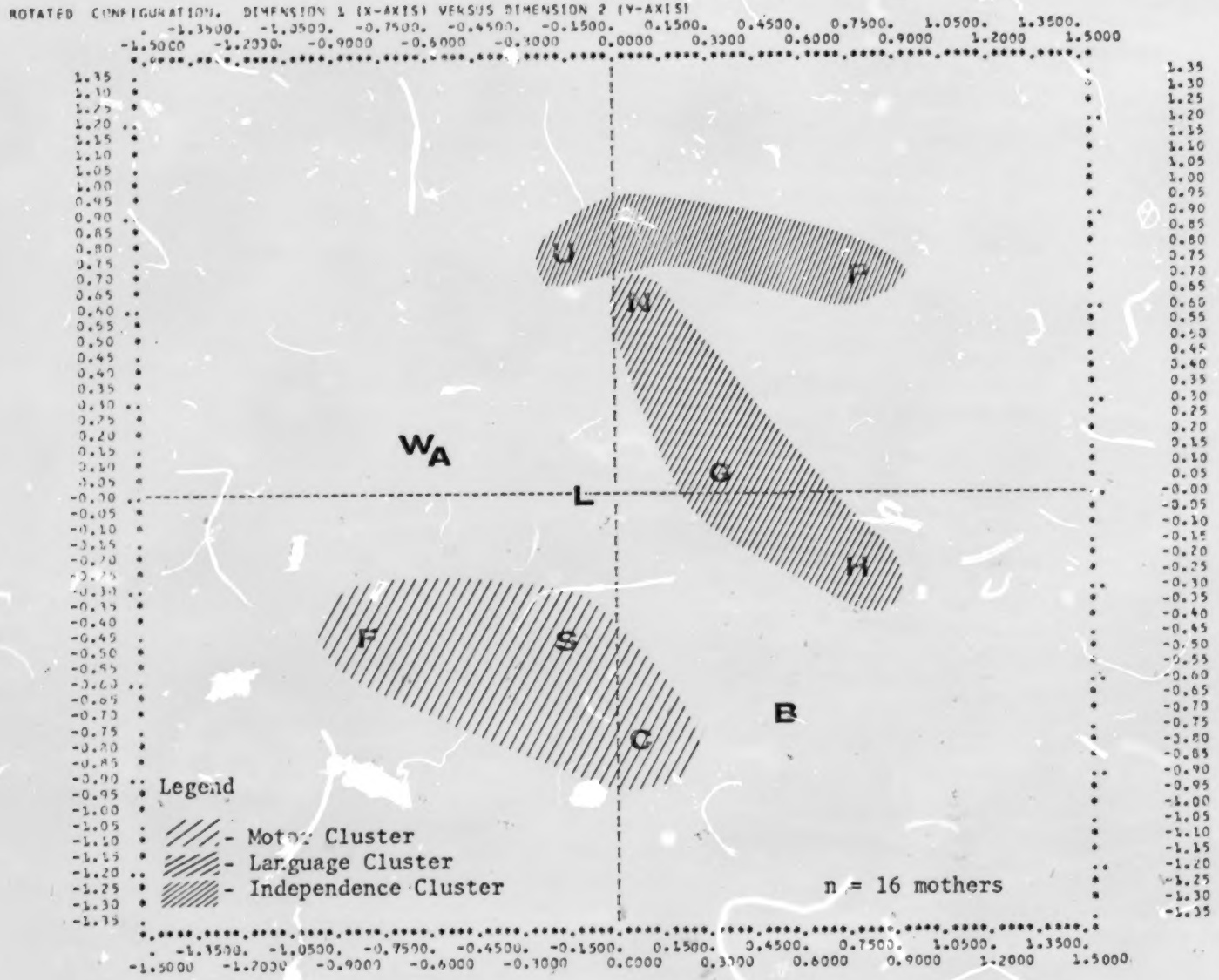
[1] Random selection of the tasks would have been ideal, but it was found that many tasks were difficult to illustrate. Some investigator bias was accepted in order to minimize the ambiguity in the illustrations.

Figure 6

Twenty-Four-Month Developmental Goals



Two other clusters were distant and therefore distinct from the motor cluster. These could be labeled language (N "Ask names of things", G "Get something and bring it to you", H "Say hi to people he knows")and social independence (U "Use cup and spoon neatly", P "Use potty chair"). Not only did these 16 mothers value these language goals and social independence goals to a similar degree, their preference was in this direction. This information reminded the curriculum developers of the practical importance of independence to mothers, especially in homes with many social stresses. The mothers' perception of language goals provided a happy congruence with the curriculum developers' biases and provided support for an increasing emphasis in language programming.

The curriculum developers were surprised to see in the 36 month goals (Figure 7) a favored cluster which might be described as school-like goals (A "Sort things that look alike", T "Tell something he has seen or done", O "Know what 'one' means", B "Build a house with blocks"). The cognitive/language emphasis of the school-like cluster provided some assurance that the parents (11 mothers) and the curriculum developers were in substantial agreement for 36 month goals. A lack of such agreement might have signaled the need for additional two-way communication and goal clarification between the Center and the parents.

*The subject matter.* As a first step in generating a kindergarten motor development curriculum, the literature was searched for goal statements on the subject matter or content of motor development programs. From these statements 15 were selected as representing a dispursed and heterogeneous set. The plan for this study is to obtain feedback from judges who are expert on the age level (kindergarten teachers) and judges who are expert on motor development (physical education teachers) and to individually analyze each judge's response. Individual scaling solutions are possible since each judge is asked to make not one but 15 rank orderings of the content statements using each statement in turn as a reference point and judging the remaining statements in terms of their similarity to the referent.

Reported in Figure 8 is the two-dimensional conjoint scaling output for the first kindergarten judge. One distinct cluster contained some of the more physical of the traditional physical education goals (J "Speed/agility", F "Reaction time", E "Endurance", C "Strength").[1] For this kindergarten teacher a second set of goals which seemed to relate movement to other fields and to general learning (A "Alternative approach", L "Basis for development", G "Goal directedness", I "Individual solutions") was maximally distinguished from the more physical goals. Intermediate between these two clusters was a group of three goals (H "Hand-eye coordination", D "Bi-lateral dominance", N "Learning disabilities") which seemed to relate to learning problems or disabilities.

The perceptions of this kindergarten teacher have provided the curriculum developers with an initial insight into subject matter organization. For example,

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[1]The goals, of course, were stated in detailed sentence form, key words only are provided here.

Figure 7

Thirty-Six-Month Developmental Goals

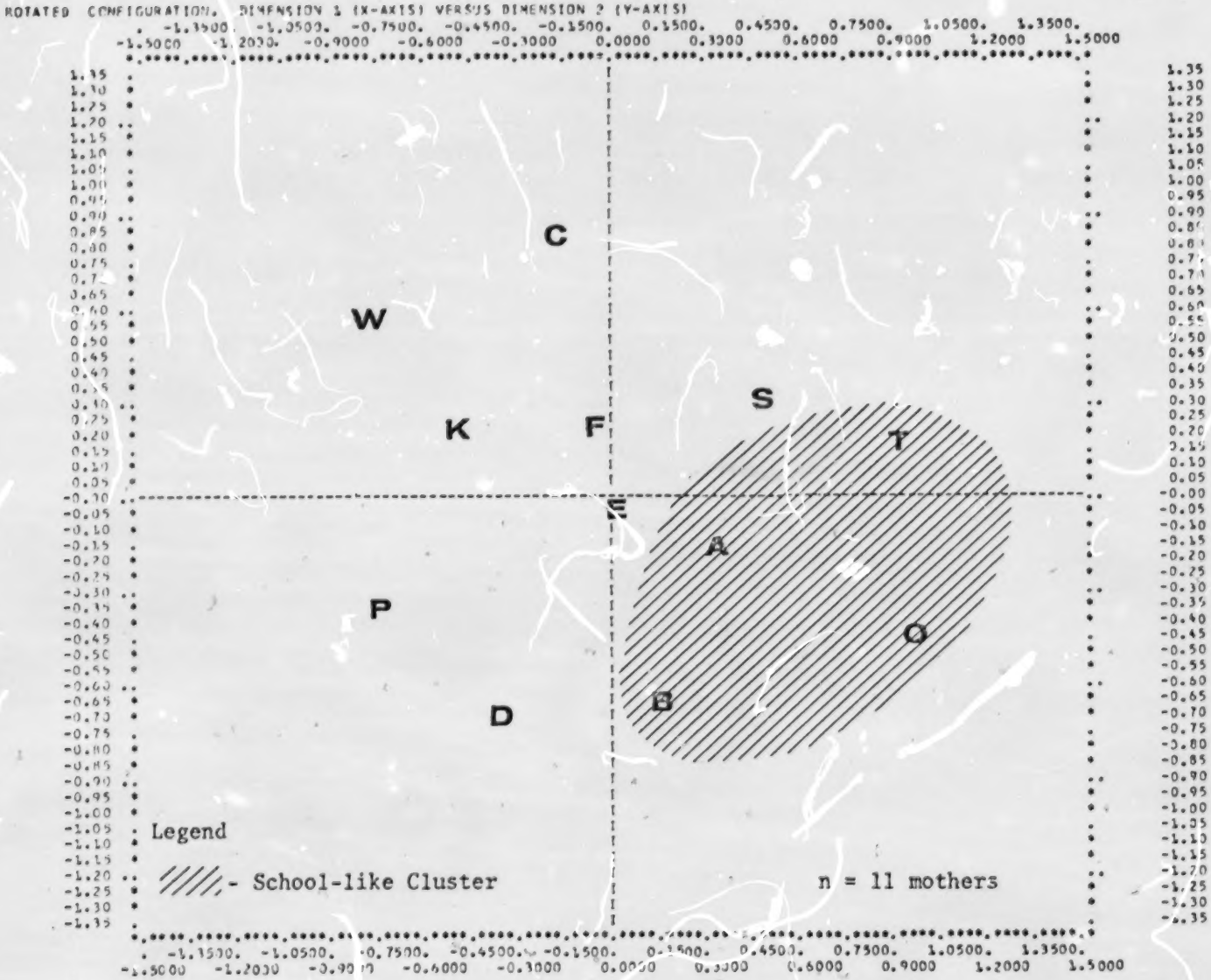
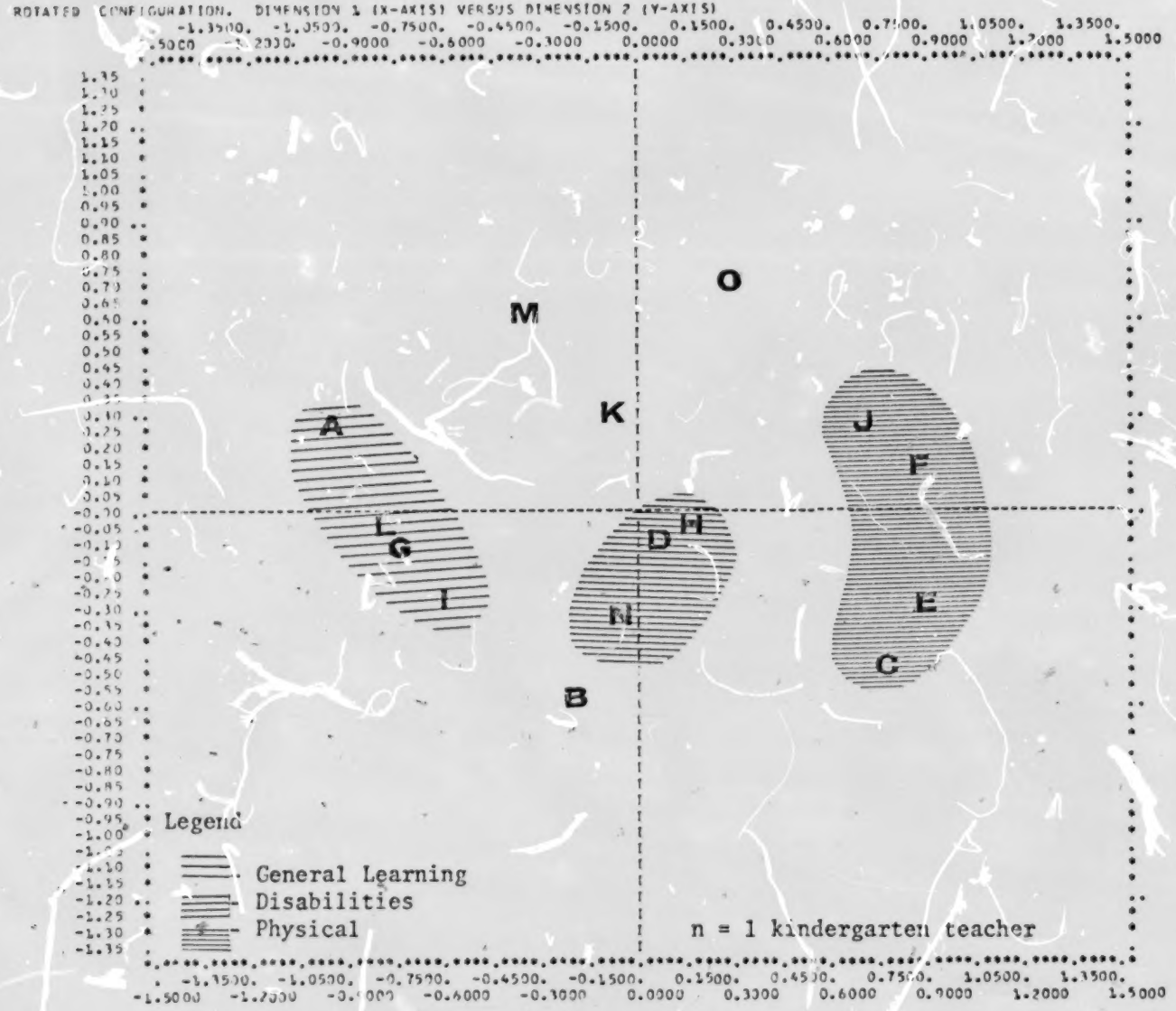


Figure 8

Content Goals for a Kindergarten Motor Development Curriculum



the strong separation or dissimilarity seen between physical and general learning goals alerts the curriculum developers that they may have to choose between accepting this split or making a major effort in the curriculum material to integrate the two areas. As the opinions of different judges are gathered the curriculum developers can move forward in establishing a subject matter organization plan.

Conclusions. Systematic methods of dealing with information from the traditional curriculum sources can contribute to the work of the curriculum developer. Multidimensional scaling provides one methodology with broad utility in this area. In the three examples given, the curriculum developers will be able to describe their completed products with some degree of confidence about their sources. In the first instance, the developer will be able to state that the pictoral materials that are eventually produced are designed to have qualities that are known to influence the attention of the selected learners. In the second instance, the developer will be able to say that the infant curriculum goals have confirmation from the parents or society to be served. In the final instance, the developer will be able to say that certain aspects of the subject matter organization of the motor curriculum were influenced by teachers and certain aspects were influenced by physical education experts. This type of information on the curriculum sources would make a welcomed addition to the description of any curriculum product.

Educational importance. Increasing sophistication of curriculum developers and curriculum users requires that the processes and decisions in curriculum development become more overt. The procedures used in these studies demonstrate the usefulness of one psychometric tool in illuminating some of the most basic curriculum development decisions. When the sources of the curriculum are apparent, potential curriculum users can more intelligently exercise their own options.

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